A Survey of Lead-in-Soil Concentrations at Seven Tot Lots in The City of Winnipeg

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A SURVEY OF LEAD-IN-SOIL CONCENTRATIONS AT SEVEN TOT LOTS IN THE CITY OF WINNIPEG

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ABSTRACT

Lead concentrations were determined for sod and soil samples from seven City of Winnipeg tot lots during the summer of 1984. The tot lots were located adjacent to major traffic thoroughfares. The Environmental Management Division was concerned that lead concentrations in soils at these playgrounds, which are frequented by young children, may be elevated. Lead concentrations ranged from 15 µg/g to 740 µg/g and were consistent with the range of lead concentrations in background soils. Lead concentrations were well below the Environmental Management Division guideline of 2600 µg/g of lead.

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1. INTRODUCTION

Lead is introduced into the environment principally from man made sources. Automobile exhaust emissions, from the burning of leaded gasoline, are the single largest contributor of lead to the environment (Downey et al 1984, Ondov et al 1982, National Research Council 1978, Reinhold and Rolfe 1976). Other sources of lead contamination include lead smelters, leaded paints and glazes as well as in cans used in the food processing industry.

It is well documented that excessive intake of lead, especially in young children, can cause lead poisoning (Rabinowitz et al 1985, Downey et al 1984, Deluca 1984, Brunekreef 1983, Brown et al 1983, Stark et al 1982, Kurzel and Cetralo 1981, Budiansky 1981, Needleman 1981, Coodin et al 1980). Lead accumulates in soil and may be a principal source of lead intake by small children (Downey et al 1984, Deluca 1984, Brown et al 1983, Marshall 1982, Coodin et al 1980, Jodokus et al 1979, Brunekreef et al 1979).

Lead-in-soil studies conducted by the Environmental Management Division in Manitoba have shown that lead concentrations in soil are often closely related to the proximity of major automobile thoroughfares (Jones and Wotton 1983, Jones 1983, Wotton 1979). A report, "Lead Particulate Analyses in Air and Soil of the City of Winnipeg, 1982" was released by the Department of Environment and Workplace Safety and Health on June 1, 1983 (Wotton and Doern 1983). A major conclusion of the report was that automobile exhaust emissions appeared to be the primary source of lead contamination at Weston School, located adjacent to a principal traffic artery. In addition, concern was raised that this might not be an isolated case and that other Winnipeg schools close to major traffic thoroughfares might also be affected.

As a follow up to information presented in the above report, the Environmental Management Division expanded its lead program to evaluate lead in soil from seven other schools in Winnipeg (Jones and Wotton 1983). In addition, seven Winnipeg tot lots were selected for lead-in-soil monitoring. These preschool playground areas fit the criteria for above average potential for lead associated health

risks. These play areas were of concern for the following reasons:

a) the close proximity to major traffic routes;
b) the young age of the children frequenting these play areas;
c) the play habits of these small children, such as crawling and pica;
d) the variability of ground cover, e.g. gravelled areas, play sand, bare soil and;
e) the fact that lead accumulates in soil.

The Department of Environment and Workplace Safety and Health is aware of the health risks associated with high concentrations of lead in soil, especially for young children. The Environmental Management Division has adopted the Ontario Ministry of the Environment guideline for lead in soil. This guideline specifies that lead in soil of residential areas or areas frequented by children should not exceed 2600 µg/g. Soils containing lead concentrations in excess of this guideline are recommended for removal.

This report presents the results of the monitoring program at seven Winnipeg tot lots.

2. PROCEDURES

2.1 Tot Lot Selection

Seven Winnipeg tot lots were selected for sampling. The tot lots were selected because of their close proximity to major traffic thoroughfares. Selection of these "worst case" play areas was made to ensure there was a potential for high lead-in-soil concentrations. The tot lots selected were:

1. Central Park - (Cumberland Ave. at Edmonton St.)
2. Home Playground - (Sargent Ave. at Home St.)
3. Notre Dame Park - (Notre Dame Ave. at McGee St.)
4. Maryland Tot Lot - (Maryland St. at Wellington Ave.)
5. Spence Tot Lot - (Cumberland Ave. at Spence St.)
6. Archibald Tot Lot - (Archibald Ave. at Provencher Blvd.)
7. Hespeler Park - (Hespeler Ave. at Glenwood Cr.)

2.2 Sample Collection

Considerable variation in ground cover was found at most playgrounds. Within each site, there was usually a combination of sodded areas, asphalt and/or gravel pathways, gravel/sand mixtures under swings and slides, sand boxes, as well as exposed black earth in flower and ornamental shrub beds.

In June, 1984 samples representing all of the major ground cover types were collected at each tot lot.

In sodded areas a two centimeter diameter stainless steel Oakfield soil corer was used to collect the sod and the upper five centimeters of soil. A series of ten sample cores were taken at each collection site. Each series of ten cores for both the sod and soil were bulked separately and stored in clean plastic bags. In areas where the ground cover type was sand, gravel or exposed organic soil a clean plastic scoop was used to collect a composite sample.

2.3 Sample Processing

Samples were taken to the W. H. Ward Technical Services Lab, 745 Logan Ave., Winnipeg, where they were placed separately into acid washed glass beakers and oven dried at 100°C for twenty-four hours. The dried samples were ground with a mortar and pestle and then screened through a stainless steel #80 Canadian Standard sieve. The sieved material was then placed into individual clean glass specimen vials. Between each sample the mortar and pestle were washed with tap water and wiped dry using clean paper towels. The sieve was cleaned by blowing compressed air through it to remove fine soil particles and then wiping it with clean gauze pads. The samples were analysed for total lead concentration by atomic absorption spectroscopy.

3. RESULTS

Lead-in-soil concentrations for the seven Winnipeg tot lots are presented in Table 1.

3.1 Central Park

Figure 1 shows sample site locations for Central Park. Lead concentrations in sod ranged from a high of 680 µg/g at sites 2 and 3 to a low of 190 µg/g at site 1. Lead concentrations in soil ranged from a high of 365 µg/g at site 2 to a low of 45 µg/g at site 6. Sites 2 and 3 had the highest levels of lead in sod and soil and were also closest to Cumberland Ave., a high traffic volume thoroughfare. Site 1 is protected by a hedge which may account for its lower value. The lowest levels were found at sites 6 and 7 - the swing stations, at 8 - the slide and at 9 - a climbing frame. Coarse sand is the dominant ground cover at these play stations.

3.2 Home Playground

Sample locations for Home playground are presented in Figure 2. Lead concentrations in sod ranged from a high of 200 µg/g at site 5 to a low of 80 µg/g at site 7. Lead concentrations in soil ranged from a high of 320 µg/g at site 2 to a low of 30 µg/g at site 10. The highest value of 320 µg/g (site 2) was immediately adjacent to Sargent Ave. However, the second highest lead value of 250 µg/g was at site 9, one of the furthest sample locations from Sargent Ave. Another anomaly exists under the swings at site 4 where the concentration was low (35 µg/g) even though the site is adjacent to Sargent Ave. Sites 2, 3 and 5 are also located adjacent to Sargent Ave. However, the levels are comparatively higher at 320 µg/g, 175 µg/g and 170 µg/g respectively.

3.3 Notre Dame Park

Sample locations for Notre Dame Park are shown in Figure 3. Lead concentrations in sod ranged from a high of 105 µg/g at site 9 to a low of 60 µg/g at sites 6 and 7. Lead concentrations in soil ranged from a high of 190 µg/g at site 1 to a low of 30 µg/g at the swing stations (2 and 4) and at the sand box, site 8.

Table 1. Lead-in-Soil Concentrations for Seven Winnipeg Tot Lots, 1984.

Sample Site #	Lead Concentration (µg/g)													
	Central Park		Home Playground		Notre Dame Park		Maryland Tot Lot		Spence Tot Lot		Archibald Tot Lot		Hespeler Park	
	Sod	Soil	Sod	Soil	Sod	Soil	Sod	Soil	Sod	Soil	Sod	Soil	Sod	Soil
1	190	145	-	160	-	190	345	155	380	320	190	160	330	235
2	680	365	-	320	-	30	310	125	245	300	270	165	145	240
3	680	280	-	175	100	125	-	180	500	450	395	295	140	120
4	390	110	-	35	-	30	-	95	-	50	-	30	-	35
5	240	235	200	170	-	100	-	120	-	40	195	110	-	15
6	-	45	110	130	60	70	-	50	360	335	110	150	200	100
7	-	100	80	80	60	70	-	30	355	260	-	-	-	50
8	-	55	170	160	-	30	-	170	-	230				
9	-	50	-	250	105	165	285	120	680	740				
10	-	130	-	30	-	50	155	145	600	640				

Figure 1. Map of sample locations for Central Park

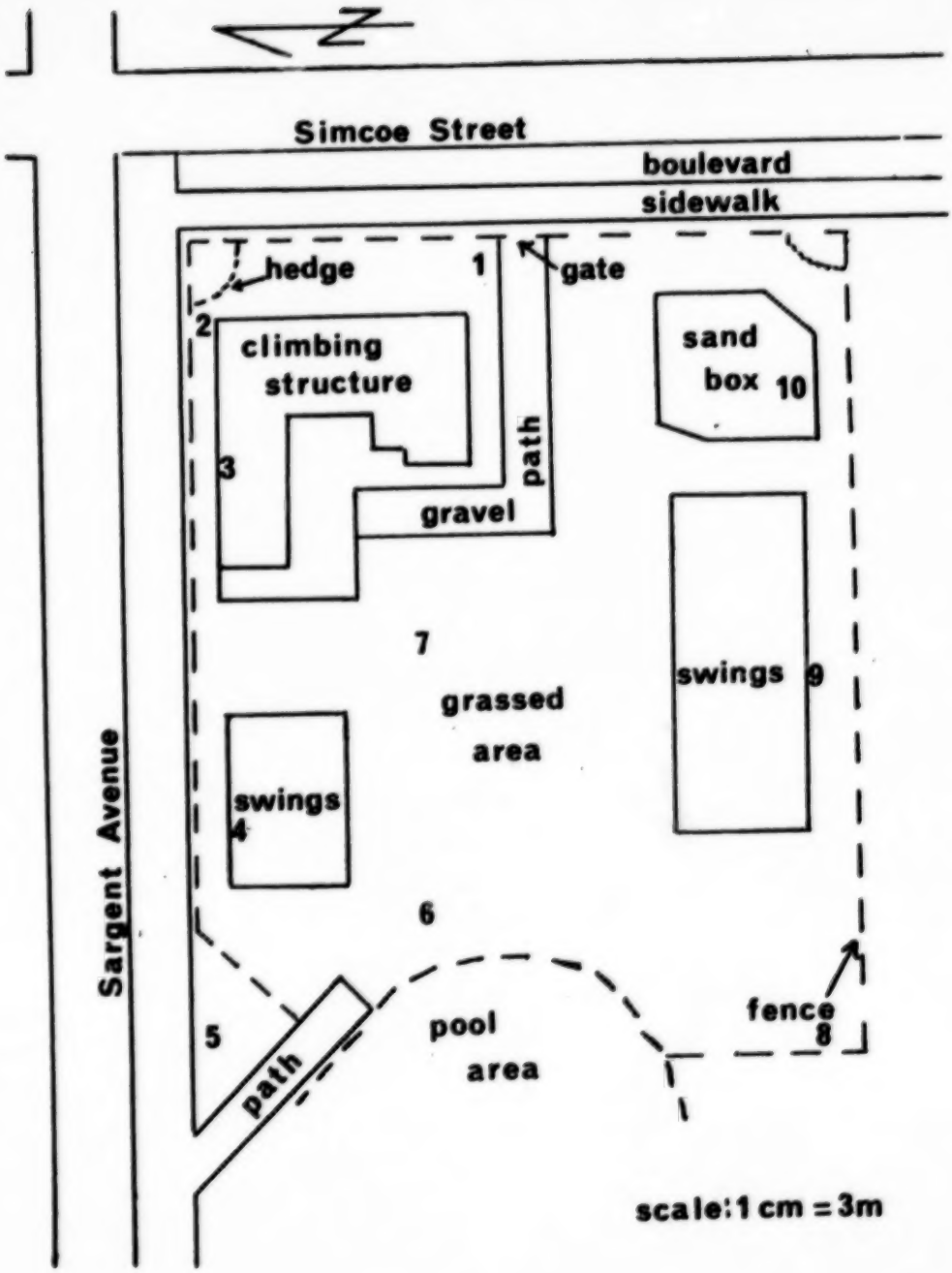

Figure 2. Map of sample locations for Home Playground

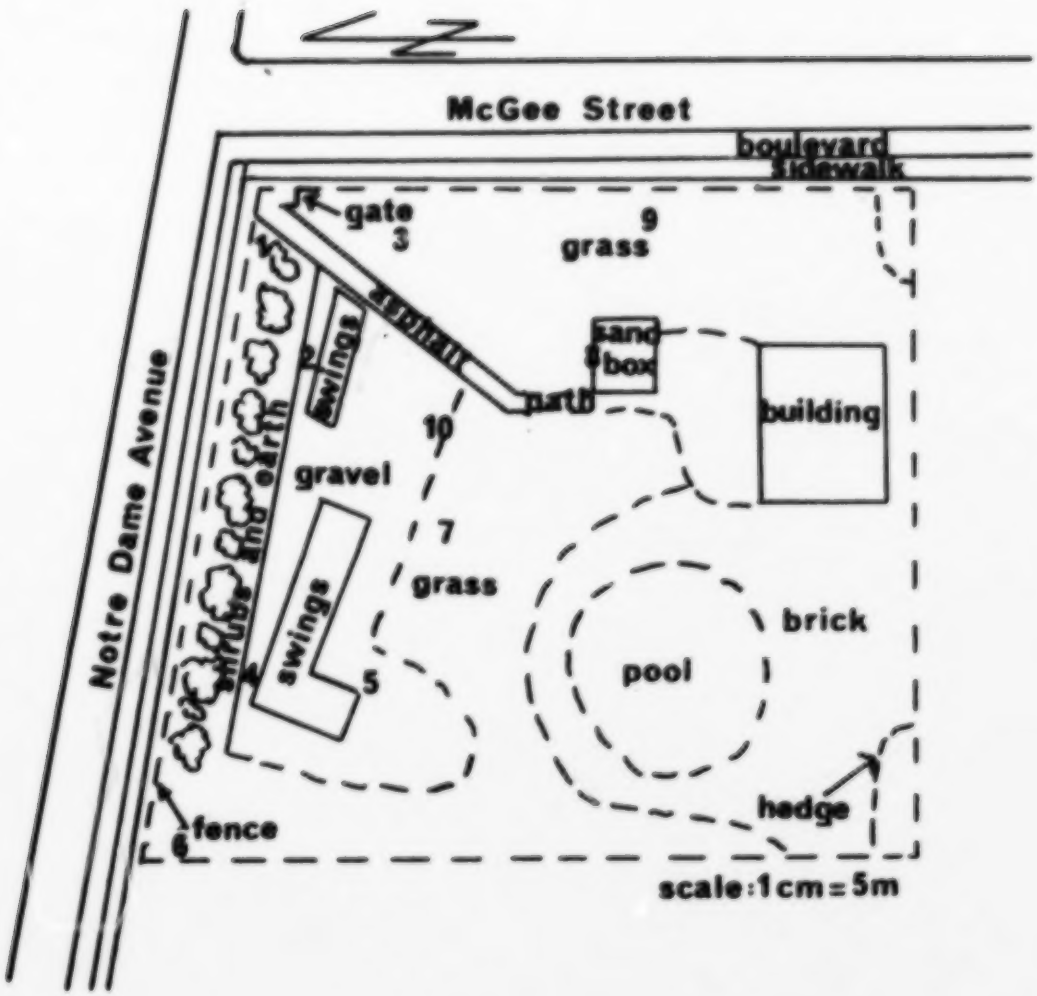

Figure 3. Map of sample locations for Notre Dame Park

3.4 Maryland Tot Lot

Sample locations for Maryland tot lot are presented in Figure 4. Lead concentrations in sod ranged from a high of 345 µg/g at site 1 to a low of 155 µg/g at site 10. In soil, lead concentrations ranged from a high of 180 µg/g at site 3 to a low of 30 µg/g at site 7. Lead concentrations at the sand box and swings were consistently lower than other locations. Generally, lead concentrations were highest immediately adjacent to Maryland St. and Wellington Ave.

3.5 Spence Tot Lot

Figure 5 shows sample site locations for Spence tot lot. Lead concentrations in sod ranged from a high of 680 µg/g at site 9 to a low of 245 µg/g at site 2. In soil, lead levels ranged from a high of 740 µg/g at site 4 to a low of 40 µg/g at site 5. The higher lead concentrations at sites 9 and 10 appear to be associated with the laneway at the west side of the tot lot leading to Cumberland Ave. Sites 1, 2 and 3, adjacent to Spence St., also had high lead concentrations. Again sites located at the sand box (site 4), slide (site 5) and the northerly swing station (site 8) had lower lead levels. Site 7, the southerly swing station had a higher than normal (355 µg/g) lead level for that type of substrate.

3.6 Archibald Tot Lot

Figure 6 shows sample locations for the Archibald tot lot. Lead concentrations in sod ranged from a high of 395 µg/g at site 3 to a low of 110 µg/g at site 6. Concentrations in soil ranged from a high of 295 µg/g at site 3 to a low of 30 µg/g at site 4. Again the lowest lead concentrations were found at the sand box (site 4) and the swings (site 5). The highest concentrations were found adjacent to Provencher Blvd. and also the laneway at the southwest end of the tot lot.

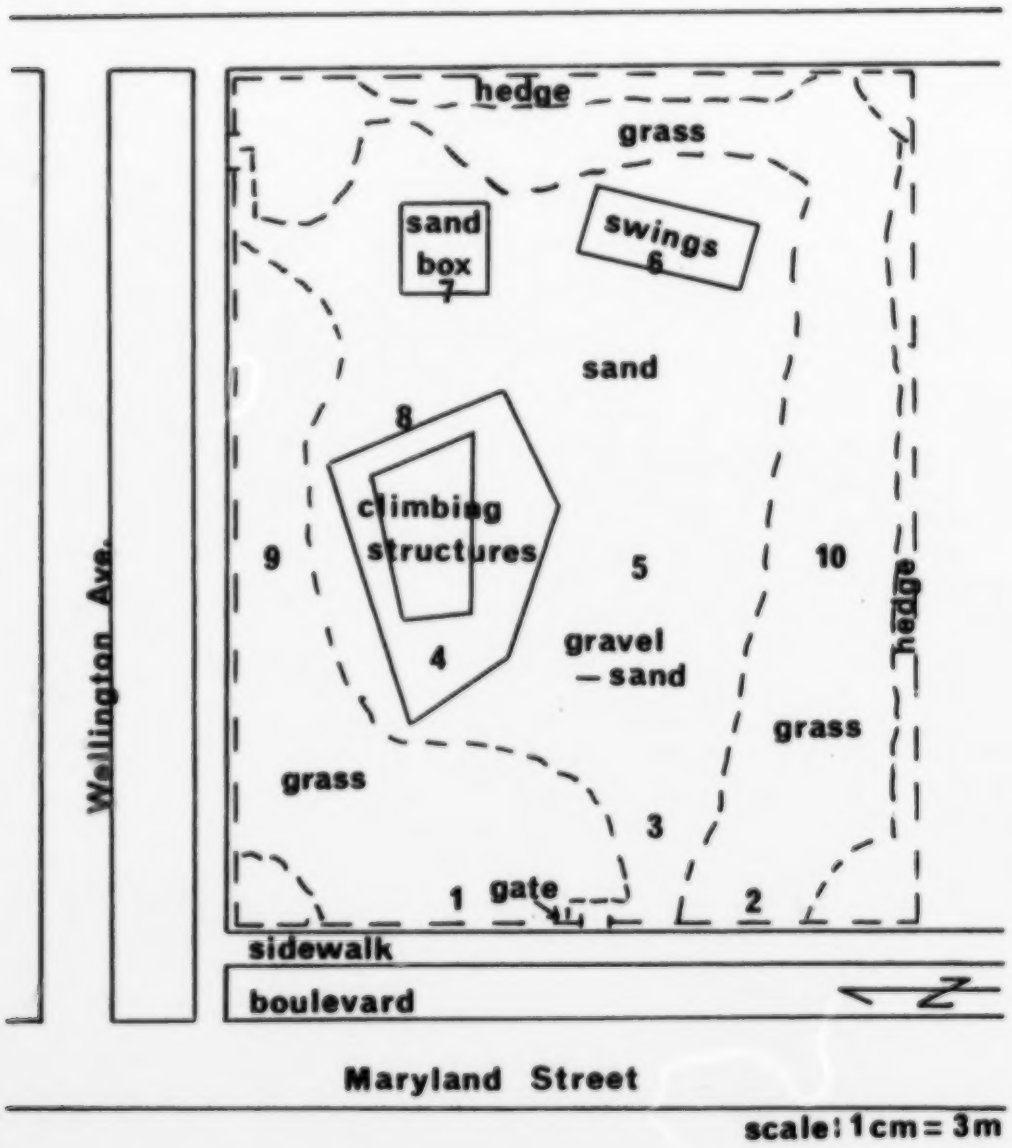

Figure 4. Map of sample locations for Maryland Tot Lot

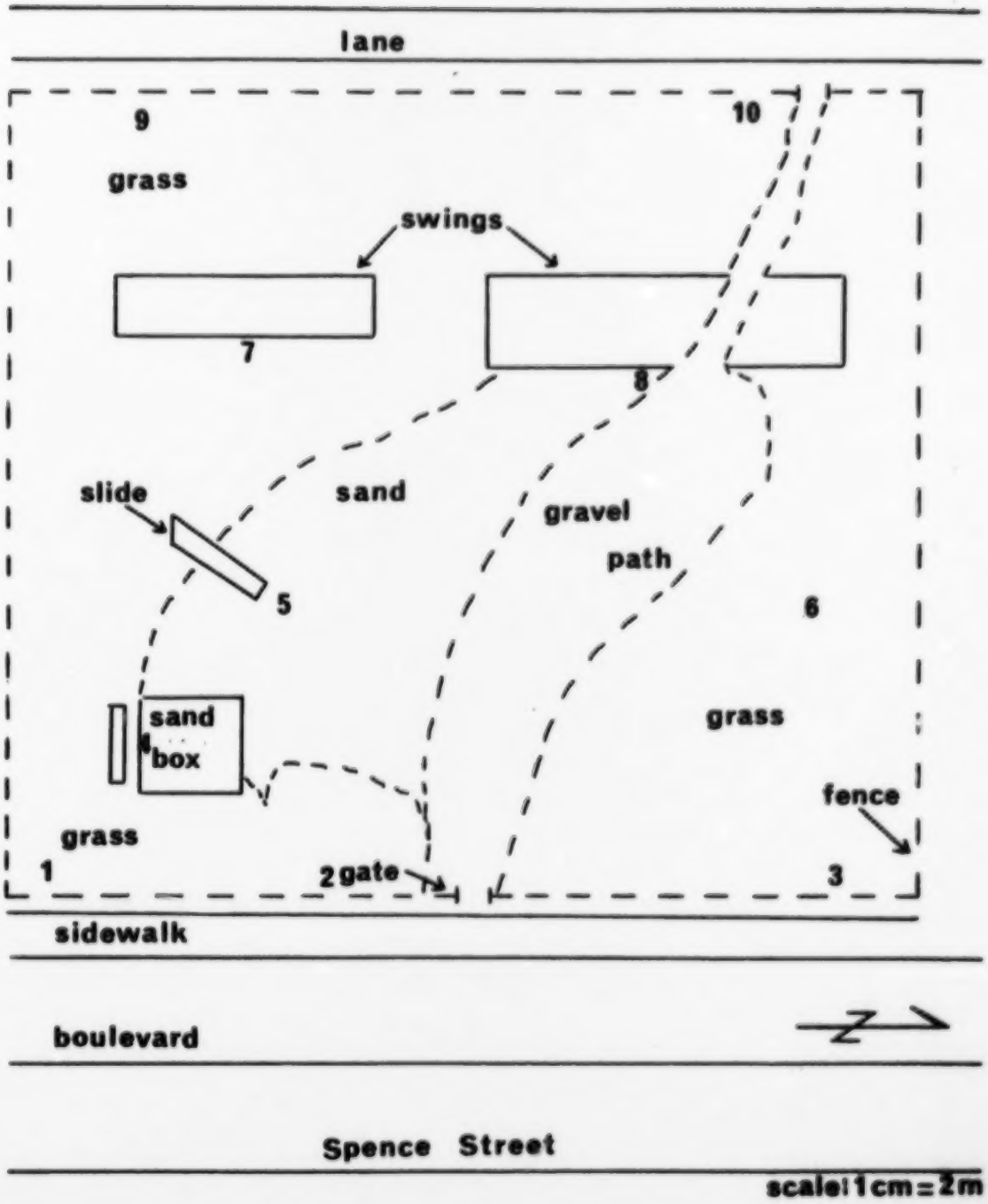

Figure 5. Map of sample locations for Spence Tot Lot

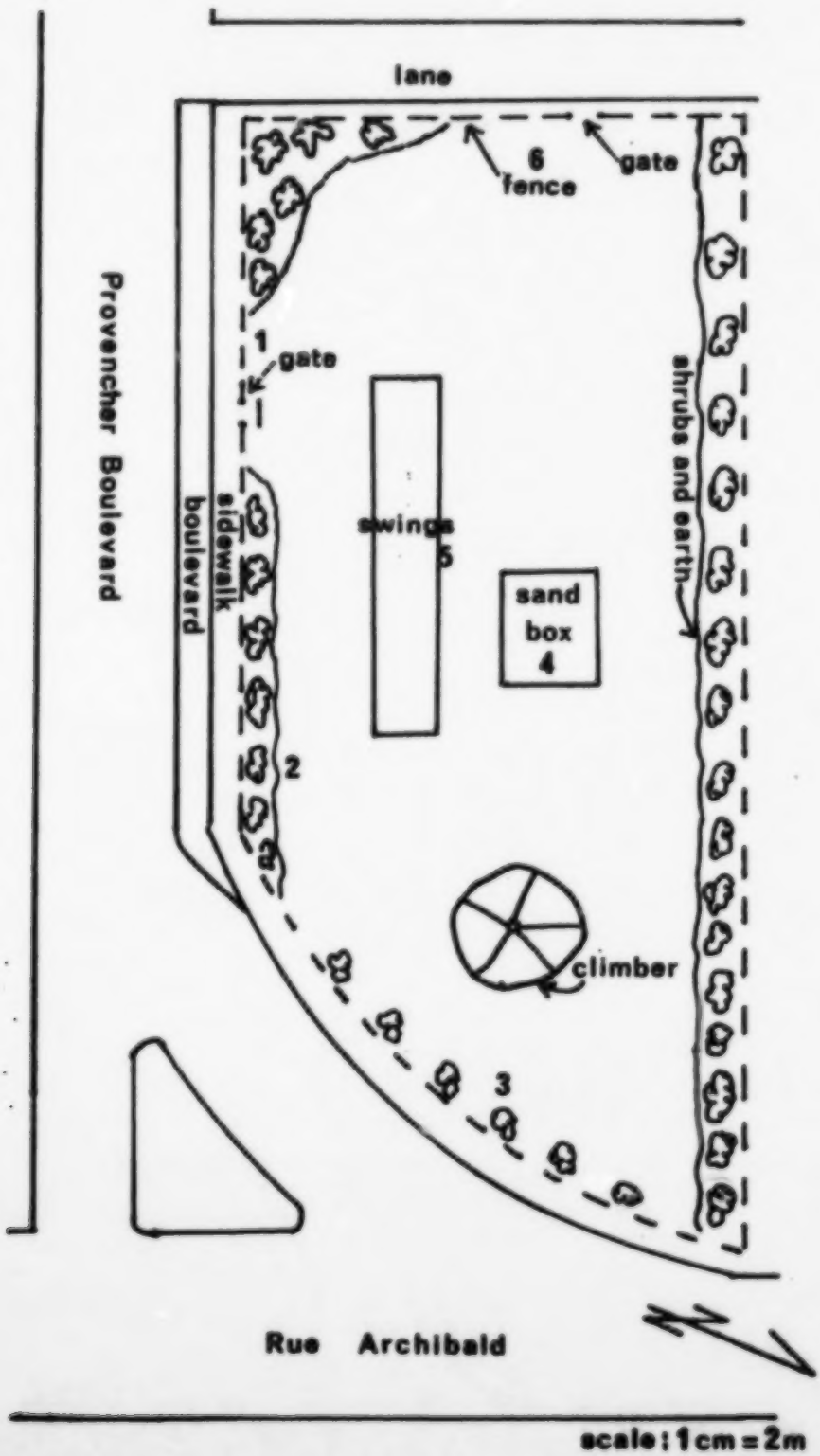

Figure 6. Map of sample locations for Archibald Tot Lot

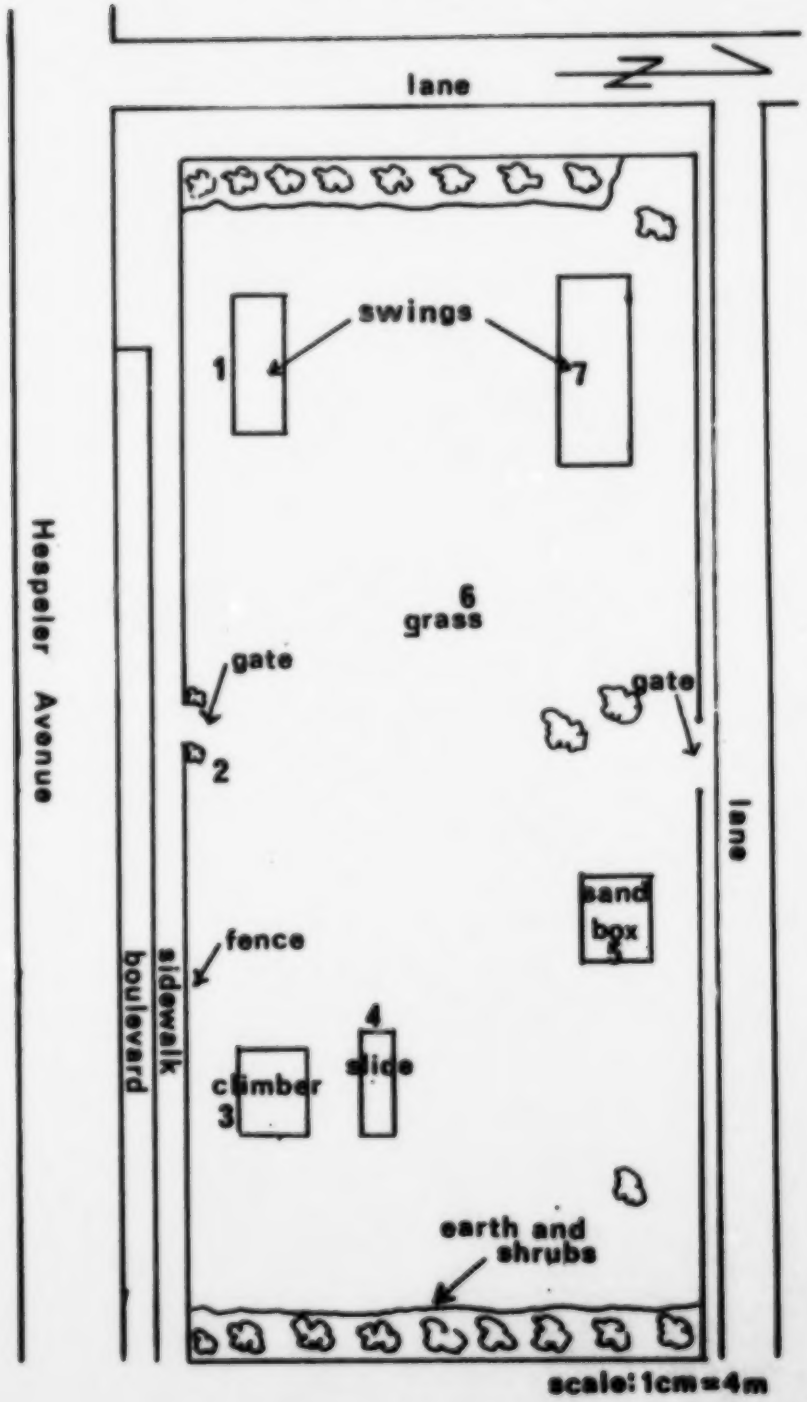

Figure 7. Map of sample locations for Hespeler Park

3.7 Hespeler Park

Sample locations for Hespeler Park are presented in Figure 7. In sod, lead concentrations ranged from a high of 330 µg/g at site 1 to a low of 140 µg/g at site 3. In soil, concentrations ranged from a high of 240 µg/g at site 2 to a low of 15 µg/g at site 5. The lowest concentrations were found at site 4 - the slide, site 5 - the sand box and site 7 - the swing with sand base. Sites adjacent to Hespeler Ave. had the highest concentrations.

4. DISCUSSION

At all seven tot lots lead concentrations were consistently lower at the sand box, slide and swing play areas where sand/gravel material was present. Concentrations of lead in sod samples were consistently higher than those found in sand. Perhaps sand is not as good a receptor of lead particulate as sod. This may relate to the low adsorption capacity for the sand/gravel which reduces its efficiency to trap lead particles. Removal by leaching down into the soil is also enhanced in materials with low adsorptive capacity. The greatest amount of play activity occurs at the swing, slide and sand box stations. It is possible that the surface layer of sand is constantly being scuffed away and redeposited at the periphery of the play station. Also, sand and gravel material at these stations is probably replaced or amended on a regular basis. This would have a dilution effect on any lead accumulation which may be occurring. Irregular schedules of replacement and amendment could account for some of the variation within the tot lots. Also, children may dig up soil and transport it to other locations within the tot lot thus redistributing lead which has accumulated. As well, children may mix the surface lead deposits with the deeper soil while digging. This would have a diluting effect thus lowering the concentration.

Even the highest concentrations in sod and soil were not in the range which is considered to be elevated. Lead levels were consistently within urban background levels found in previous Environmental Management Division studies. Also, the pattern of accumulations were consistent with the results from other studies

which showed that lead concentrations tended to be higher at sites closest to major traffic thoroughfares.

5. CONCLUSIONS

1. Lead concentrations in sod and soil samples taken from seven tot lots within the City of Winnipeg were all well below the Environmental Management Division guideline of 2600 µg/g of lead.
2. Lead concentrations at the seven tot lots were within the expected range of background concentrations for soils in the City of Winnipeg.
3. Generally, lead concentrations were highest immediately adjacent to high traffic volume thoroughfares.
4. Lead concentrations tended to be lowest in the sand/gravel soil medium at play stations such as swings, slides and sand boxes. This is particularly important in a positive sense because that is where the greatest amount of play activity usually takes place.

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